AE 340 Lab 4: Planters/Spinning Disks Due Thurs. 5 Oct. 2006

Question1: A seeder is used to broadcast alfalfa at a seeding rate of 20 kg/ha, at a travel velocity of 14.4 km/hr, with a 10m swath width, through a circular orifice. The following information of alfalfa is provided.

Bulk Density .77 kg/L, Seed Count 339,000 seeds/L,
Germination rate 80%, Mean Diameter 1.53 mm,
Seed Density 1184 kg/m^3, Terminal Velocity 5.69 m/s

Determine:

i). Flowrate through the orifice required for this application rate.
ii). The orifice diameter to achieve this flowrate.
iii). The minimum application rate possible for alfalfa seeds, at this velocity and swath width, without irregular application.

Question 2: A seeder is used to broadcast alfalfa at a seeding rate of 25 kg/ha, at a travel velocity of 10.8 km/hr, with a 10m swath width, through a square orifice. The following information of alfalfa is provided.

Bulk Density .77 kg/L, Seed Count 339,000 seeds/L,
Germination rate 80%, Mean Diameter 1.53 mm,
Seed Density 1184 kg/m^3, Terminal Velocity 5.69 m/s

Determine:

i). Flowrate through the orifice required for this application rate.
ii). The orifice size to achieve this flowrate.
iii). The minimum application rate possible for alfalfa seeds, at this velocity and swath width, without irregular application.

Question 3: A seeder is used to drill alfalfa at a seeding rate of 10 kg/ha, at a travel velocity of 14.4 km/hr, with a 0.10m row width, through fluted wheel metering device, with 10 cells. The following information of alfalfa is provided.

Bulk Density .77 kg/L, Seed Count 339,000 seeds/L,
Germination rate 80%, Mean Diameter 1.53 mm,
Seed Density 1184 kg/m^3, Terminal Velocity 5.69 m/s

Determine:

i). Flowrate through the fluted wheel required for this application rate.
ii). The required speed of rotation, if the individual cell volume is 113 mm^3
iii). Determine the seeding rate under these conditions if 50% of the cell volume of the fluted wheel is covered.

Question 4: A precision planter is used to plant corn in 0.762 cm rows (30"), traveling at 7.2 kmh (4.5 mph). The target population after germination is 74,000 plants/ha (30,000 plants/acre), and the germination rate is 80%. The rolling radius of the planter wheel is 0.30m (12") and has a slip of 5%.

Determine:

i). The actual planting population required
ii). The nominal seed spacing of the plants.
iii). The required rotational speed of the metering device.
iv). The ratio of the metering disk speed to the planter wheel speed.

Question 5: A centrifugal spreader is designed with the following specifications.

Inner radius of disk (material drop radius) = 0.075m
Outer radius of disk = 0.20 m
Coefficient of Friction = 0.30
Disk angle = 12.5 degrees
Blade Angle = 15 degrees (Assume a logarithmic blade profile)
Disk Speed = 500 rpm
Spreader forward velocity = 14.4 kmh

The seed drop opening is directly in front of the axis of rotation of the disk and the disk height is 1.5m above the ground

Calculate the following information

(i) The angle of disk rotation before the seeds leave the disk.

(ii) The velocity of the seeds relative to the blades of the disk.

(iii) The horizontal component of the seed velocity, relative to the disk and the departure angle of the seed as it leaves the disk.

(iv) The vertical component of the seed, relative to the disk.

(v) The horizontal velocity of the seed in the direction of vehicle travel and perpendicular to the direction of travel, relative to an observer on the ground.

(vi) Assuming that the drag forces on the seed result in an average velocity that is half the initial velocity (not a good assumption), determine the time before the seed falls to the ground.

(vii). Determine the total horizontal distance the seed will travel (in the direction of vehicle travel and perpendicular to the direction of travel) from the piont of release of the seed onto the plate, relative to an observer on the ground.